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LISTS OF SPECIES

Fish larvae from the Gulf of California to Colima, Mexico: An update

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ABSTRACT: An updated taxonomic list of marine fish larvae from the Gulf of California to Colima, Mexico is presented. A total of 579 taxa belonging to 119 families, 256 genera, and 423 species were recorded. The list was compiled using 14 publications on fish larvae research (1974-2012), and the fish larvae identified from 315 samples collected with Bongo nets during 10 oceanographic cruises made from the Gulf of California to Bahía de Banderas, Mexico, from 2003 to 2007 (this study). The most important families in this study were the Myctophidae (28.3%), Engraulidae (25.0%), and Clupeidae (15.4%). The most abundant species were *Cetengraulis mysticetus* (18.2%), *Benthosema panamense* (13.9%), and *Opisthonema libertate* (12.7%). The compiled taxonomic list shows the addition of 296 new taxa to the previous list published 10 years ago, and also the need of an increase in the effort on the taxonomy of fish larvae forms not identified to species level.

INTRODUCTION

Ichthyoplankton studies in the Gulf of California began almost 40 years ago when Moser *et al.* (1974) collected plankton during six oceanographic cruises made during 1956-1957 and published the first list of the occurrence and abundance of marine fish larvae. Moser (1996) provided the most important taxonomic tool for the identification of the early stages of fish larvae in the California Current, which account for an important number of species in the Gulf of California, while Aceves-Medina *et al*. (2003) contributed with the first and most extensive systematic list to that date. Many other early ichthyoplanktonic studies targeted only the main commercial species such as the Pacific sardine and the northern anchovy (Hamman *et al*. 1988; Green-Ruiz and Hinojosa-Corona 1997).

More recently, ichthyoplanktonic research related to the study of fish larvae abundance, distribution, and their relationship to environmental factors and mesoscale processes was conducted throughout several areas from the Gulf of California to the oceanic area in front of Colima (Franco-Gordo *et al*. 1999; 2003; Ávalos-García *et al*. 2003; Sala *et al*. 2003; Sánchez-Velasco *et al*. 2004; 2007; González-Armas *et al*. 2008; Peguero-Icaza *et al*. 2008; Silva-Segundo *et al*. 2008; Avendaño-Ibarra *et al*. 2009; León-Chávez *et al*. 2010; Contreras-Catala *et al*. 2012; Avendaño-Ibarra *et al*. 2013). Some of these included taxonomic lists of the fish larvae identified. At the same time, a strong sampling effort (10 oceanographic cruises from 2003 to 2007) directed to identify fish larvae communities and other zooplankton components and their relationship to the pelagic environment, provided the clues to determine a change in the status of our knowledge of the diversity in the Mexican Pacific area.

The main objective of our study was to incorporate all the new taxa we recognized during the 2003-2007 study, and those from the last 10 years of published fish larvae studies, into an updated taxonomic list of the larval fish communities present in the area from the Gulf of California to Colima, Mexico.

MATERIALS AND METHODS

The study area includes two biogeographic provinces: the Mexican and the Cortez provinces; and it is located at the northernmost region of the Eastern tropical Pacific in front of Mexico (Figure 1) comprising from 32° N to 20° N and from 116° W to 105.5° W. The Gulf of California is a semi-enclosed dynamic sea where strong changes in temperature, salinity, and currents are related to the seasonal flux of the Gulf of California and Tropical Surface Water masses, which cause latitudinal and coastal-oceanic gradients in the physical, chemical, and biological characteristics (Gaxiola-Castro *et al*. 1999). This area provides a unique environment where the southern tropical, subtropical, and northern temperate marine biota develops (Castro-Aguirre 1995; Aceves-Medina *et al.* 2003). Based on bottom topography and physical processes, five contrasting regions have been described in the Gulf of California (Lavín *et al*. 1997; Lavín and Marinone 2003). The Northern Gulf of California region (NGC), located to the north of the archipelago of the large islands, has an anticyclonic circulation most of the year, while in June and September it reverses to a cyclonic gyre (Jiménez *et al*. 2005). In this area, the ichthyofauna is primarily of temperate affinity (Castro-Aguirre 1995). The archipelago zone (area around Isla Tiburón, Ángel de la Guarda, and San Esteban), represents a boundary between

the northern and southern gulf (Figure 1), with thermal fronts induced by vertical mixing at the sills (≈400—600 m depth) of the archipelago that maintain low temperatures (Lavín *et al*. 1997; Soto-Mardones *et al*. 1999) and high chlorophyll concentrations throughout the year (Pegau *et al*. 2002; Espinosa-Carreón and Valdéz-Holguín 2007). The Southern Gulf of California (SGC) is located from the lower limit of the archipelago through Cabo San Lucas at the tip of the Baja California peninsula, and it is characterized by, among other features, strong upwelling and oceanic fronts particularly during winter-spring, deep basins with depths that range from 1000—3000 m, and warm sea surface temperature with small variations throughout the year (Soto-Mardones *et al*. 1999; Lavín and Marinone 2003). This area presents a mixture of tropical and temperate species. The continental coast of the gulf is characterized by a broad continental shelf and mostly sandy beaches, while the peninsular side has a narrow continental shelf and rocky beaches. The Entrance Zone of the gulf (from the tip of the Baja California peninsula and El Dorado, Sinaloa to Cabo Corrientes, Jalisco) is located in the Eastern Tropical Pacific (ETP) in front of Mexico. It is a transitional ocean region associated with the seasonal confluence of tropical water brought to the area by the poleward Mexican Coastal Current (Kessler 2006; Lavín *et al.* 2006), and subarctic water from a branch of the California Current System which, instead of flowing westward to join the North Equatorial Current, flows equatorward parallel to the coast of Mexico (Kessler 2006). In this area, submarine canyons, a narrow continental coast, an intense mesoscale activity consisting of fronts between the California Current, Gulf of California, and Tropical Surface Water masses, and eddies and filaments (related to wind originated coastal upwelling) are observed year-round (Torres-Orozco *et al.* 2005; Zamudio *et al.* 2007). The presence of all these features, and also of a number of islands, may promote and enhance a wide variety of habitats linked to a complex and diverse ichthyoplanktonic community. The oceanographic region from Jalisco to Colima presents a narrow continental shelf (Filonov *et al*. 2000). It is influenced by the poleward flow of the Costa Rica Coastal Current (CRCC) almost all the year, which is more or less intense according to the change of position of the intertropical convergence zone, and plays an important role carrying tropical and subtropical biota to northern latitudes. The variability in this region is influenced by interannual, interseasonal (equatorially generated), and higher frequency (storm-induced) signals (*e.g.* coastally trapped Kelvin waves) (Zamudio *et al*. 2001; 2008).

A total of 315 plankton samples were collected during ten oceanographic cruises from November 2003 to August 2007 (this study). These included three transects made in the gulf from Bahía de La Paz, Baja California Sur to Bahía de Banderas (Figure 1). The cruises included the following months: November 2003, 2004, 2005, and 2006 (S-189, S-195, GOLCA0511, and S-207); March,

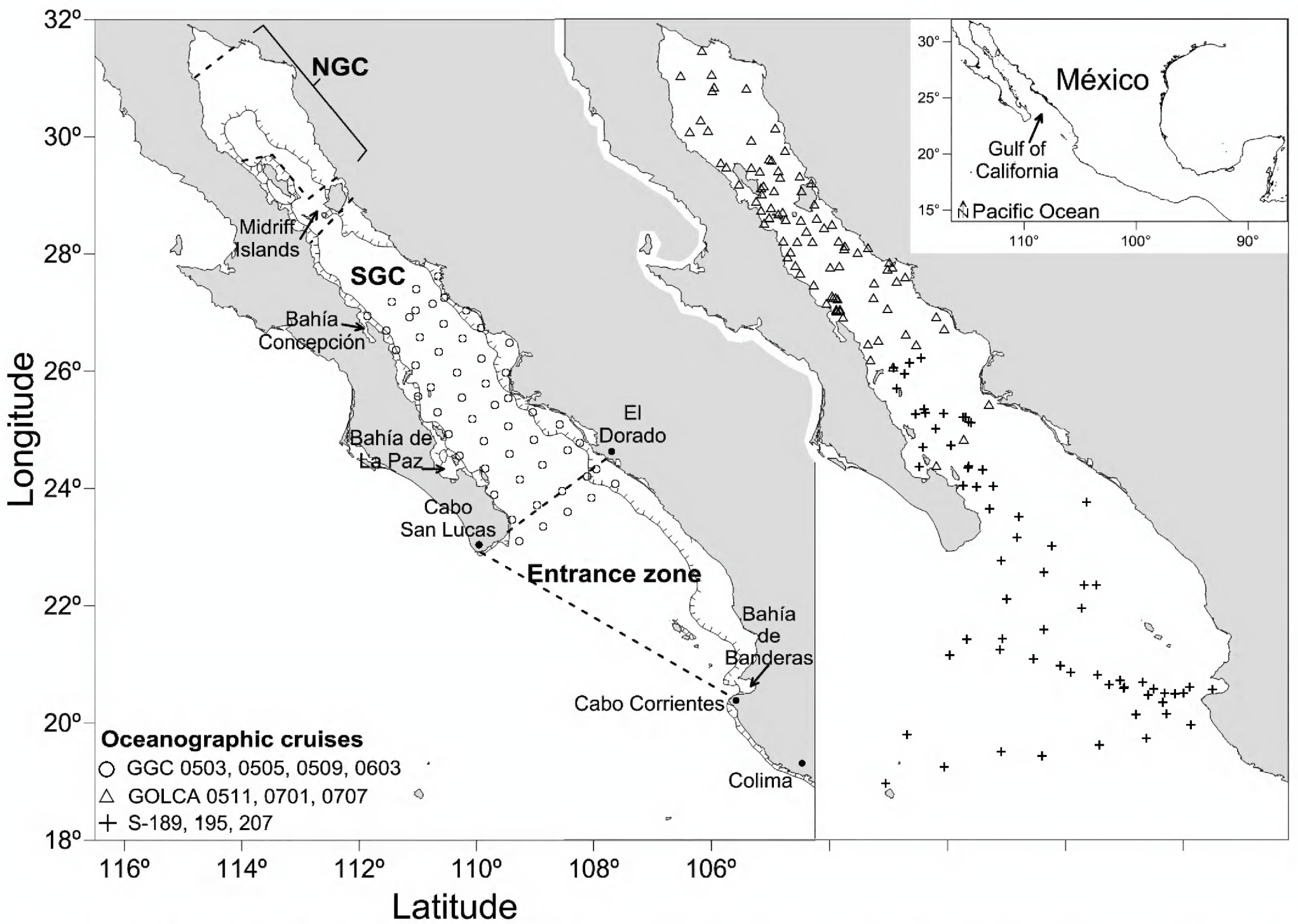

Figure 1. Study area and sampling grid stations covered during the 10 oceanographic cruises made from the Gulf of California to Colima, Mexico, from 2003-2007. NGC = Northern Gulf of California, SGC = Southern Gulf of California. Dashed line indicates the 200 m depth isoline.

May, and September 2005, and March 2006 (CGC0503, CGC0505, CGC0509, and CGC0603); and January and July 2007 (GOLCA0701 and GOLCA0707). Cruises were made on board the B/O H05 *Altair* and B/O H03 *Alejandro de Humboldt* of the Secretaría de Marina, Armada de México; on the B/O *El Puma* of the Universidad Nacional Autónoma de México; and on the sailing vessel SSV *Robert C. Seamans* of the Sea Education Association, Woods Hole Laboratory, Massachusetts, U.S.A. For the six cruises (CGC0503, CGC0505, GOLCA0511, CGC0603, GOLCA0701, GOLCA0707), plankton samples were obtained from oblique tows by means of standard Bongo net tows (Smith and Richardson 1979), or with a conical 1 m diameter net (S-195 and S-207 cruises, 505 µm pore size) that was towed using the same Bongo nets methodology. During the September 2005 cruises (CGC0509), plankton samples were collected using only a surface conical net. Additional Neuston surface tows (345 µm pore size) were made during the cruises S-189, S-195, and S-207. In all cases the nets were fitted with calibrated flow meters. After collection, samples were drained and immediately fixed in 96% ethyl alcohol, followed by a full change of preservation fluids 24 hours later. In the laboratory, the ichthyoplankton was sorted from the entire zooplankton samples. In the case of bongo samples, only the larvae from the 505-µm mesh net were analyzed. Fish larvae were identified to the lowest possible taxonomic level, mainly using Moser *et al*. (1984), Moser (1996), Beltrán-León and Ríos (2000a, b), and Richards (2006a, b), and preserved in 96% alcohol. The number of larvae was standardized to 10 m^2 of sea surface (Smith and Richardson 1979). No samples were taken for DNA analysis. The taxa list follows the Eschmeyer, W. N. Catalog of Fishes electronic version (updated 04/01/13) (Eschmeyer 2013), and the updated species names, faunistic affinity, and habitat, follow the Fish Base (updated 12/2012) (Froese and Pauly 2012) web pages. The genera and their respective species are presented in alphabetical order. Voucher specimens were cataloged and deposited in the Ichthyoplankton Collection of the Mexican North Pacific (acronym ICTIOPLANCTON) at CICIMAR in La Paz, BCS, Mexico (catalog number SEMARNAT B.C.S.-INV-196-06-07). Some larvae were not identified to species level because of the lack of larval descriptions of species inhabiting the area or due to damaged larvae. These were distinguished with the genera name plus the notation "sp." followed by a number to denote the number of different morphological forms in each recognized taxa.

The list of species presented in this paper, comprises not only the results of the identified larvae from the ten oceanographic cruises made in this study, but also the compilation of 14 species lists of fish larvae of several areas located from the Gulf of California to the coasts of Jalisco-Colima published in oceanographic or ecological studies between 1974 and 2012. When compiling the list, we noted that different formats for species level were used by different authors in their published lists, *e. g.* ("*Diplectrum* type 1, *Diplectrum* T1, *Diplectrum* sp. A, or *Diplectrum* sp."). As a result, we adjusted them to fit the "*Diplectrum* sp. n" format in which "n" represents a number to denote the number of morphological forms reported per author. The same was observed at family level. In this case, we only mentioned the family in the list and included a table where the number of forms registered per family, per author is presented. Lists of species from bays or coastal lagoons in the study area were not included.

The species list presented by Aceves-Medina *et al.* (2003) was used as baseline to determine the historical addition of new taxa in each of the 14 lists and in this study. Our study represents the most recent addition to the list, and to our knowledge, the additional taxa we found were never registered before by the former authors.

Results

A total of 28,066 specimens belonging to 378 taxa were identified from November 2003 to July 2007 in this study. These taxa were identified two to order level, 77 to family level, two to subfamily level, 99 to genera, and 198 taxa to species level. The most important families during this study were the Myctophidae (28.3%), Engraulidae (25.0%), Clupeidae (15.4%), Phosichthyidae (10.4%), Bathylagidae (4.4%), Scombridae (3.3%), Carangidae (1.6%), Paralichthyidae (1.4%), and Gobiidae (1.3), which altogether comprised >90% of the total larval abundance. Twenty species (Table 1) from 11 families were the most abundant in the studied area. Most of the species were of tropical affinity.

Table 1. Relative abundance (Ab) of the most important taxa collected in the Gulf of California to Colima, Mexico, during this study (November 2003 to July 2007). Faunistic affinity (Aff): tropical (tr), subtropical (st), and temperate (tm). Habitat (Hab): shallow demersal (sd), coastal pelagic (cp), ocean epipelagic (op), and mesopelagic (mp).

TAXA	Ab (%)	Aff	Hab
Cetengraulis mysticetus (Günther, 1867)	18.2	st	cp
Benthosema panamense (Tåning 1932)	13.9	tr	sd
Opisthonema libertate (Günther, 1867)	12.7	tr	cp
Vinciguerria lucetia (Garman, 1899)	10.4	tr-st	mp
Diogenichthys laternatus (Garman, 1899)	7.7	st	mp
Engraulis mordax Girard, 1854	6.8	st	cp
Triphoturus mexicanus (Gilbert, 1890)	5.8	st	mp
Leuroglossus stilbius Gilbert, 1890	4.3	tm-st	mp
Sardinops sagax (Jenyns, 1842)	1.8	st	cp
Gobiidae	1.2		
Scomber japonicus Houttuyn, 1782	1.0	st	cp
Citharichthys fragilis Gilbert, 1890	0.8	st	sd
Sciaenidae	0.8		
Hygophum atratum (Garman, 1899)	0.8	tr-st	bp
Oligoplites saurus inornatus (Bloch & Schneider, 1801)	0.7	st	cp
Auxis thazard thazard (Lacepède, 1800)	0.7	tr	op
Scomberomorus sierra Jordan & Starks, 1895	0.7	tr	cp
Thunnus sp. 1	0.6		
Etrumeus teres (DeKay, 1842)	0.6	st	cp
Eucinostomus dowii (Gill, 1863)	0.6	tr	sd

In this study, the Myctophidae, Phosichthyidae, Engraulidae, and Clupeidae families were the most important in the Gulf of California accounting for 79.0% of total larval abundance. Similar results were found by Moser *et al*. (1974) and Aceves-Medina *et al*. (2003) that recorded 71.8% and 82.4% respectively (Table 2). The slight differences in the relative abundance by family were the result of the collection of less myctophyds, but more Engraulidae and Clupeidae fish larvae in our study, compared to the relative abundance of these families in

the collections of Moser *et al.* (1974) and Aceves-Medina *et al.* (2003) (Table 2). These authors also recorded that the main characteristic of the larval fish community of the gulf was the dominance of the mesopelagic and coastal pelagic taxa. In this study, mesopelagic and coastal pelagic taxa contributed almost in the same proportion to the total larval abundance (43.3 and 43.9% respectively), very similar to the records of Moser *et al.* (1974) (Table 2).

Table 2. Comparative relative abundance (%) of the most important taxa by family and habitat, collected in the Gulf of California to Colima and Eastern Tropical Pacific. (A) Aceves-Medina *et al.* 2003; (B) Moser *et al.* 1974; (C) Brogan 1994; (D) Acal 1991; (E) Ahlstrom 1971.

	A	B	C	D	E	This study
FAMILY						
Myctophidae	45.3	33.5		16.2	49.7	28.3
Engraulidae	20.1	1.4	0.9	2.2	0.2	25.0
Clupeidae	10.2	14.1	21.7	1.7	0.1	15.4
Phosichthyidae	6.8	22.8	1.9	8.9	20.7	10.4
HABITAT						
Mesopelagic	55.0	41.9	3.1	18.5	78.0	43.3
Coastal pelagic	34.0	43.2	27.0	72.4	2.7	43.9
Shallow demersal	9.5	9.3	64.6		1.8	9.2

Discussion

In our study, we found that extremely high abundances of *Cetengraulis mysticetus* (40,149 Larvae/10 m^2) not recorded by Moser *et al.* (1974) or Aceves-Medina *et al.* (2003), and of *Opisthonema libertate* (24,252 Larvae/10 m^2) collected in two sampling stations very close to each other located in the northern gulf, indicated an spawning event produced by the coupling of reproductive strategies of the species to mesoscale processes in that area (Avendaño-Ibarra *et al.*, 2013). Consequently, these high abundances influenced the relative abundance of the entire community. Excluding the abundance of these two stations from the analysis, the aforementioned mesopelagic families accounted for 60.2%; coastal pelagic families reached only 19.8%, while a decrease in the shallow demersal (8.1%) was observed.

Sampling directed to reef fish larvae communities inside the gulf only showed presence of coastal pelagic (27.0%), and dominance (64.6%) of shallow demersal taxa over all previous reports (Brogan 1994) (Table 2). To the southeast of our study area, in the Mexican Central Pacific, Acal (1991) reported also a different species community, with dominant coastal pelagic (72.4%), followed by mesopelagic species (18.5%). In contrast, in the Eastern Tropical Pacific, Ahlstrom (1971) reported dominance of mesopelagic species.

The compiled taxonomic list of taxa registered from the Gulf of California to the Colima area since 1974 to 2012 (including the results of this study) indicates a total of 579 taxa. From these, 306 were identified to species, 173 to genera, 94 to family, four to subfamily, and two taxa to order level (Table 3). These numbers indicate an addition of 296 new taxa since the most complete systematic list published ten years ago by Aceves-Medina *et al.* (2003) (283 taxa and 173 species), sampled from the north area of the Gulf of California to Bahía de La Paz. The taxa increment reported in our compiled list resulted from a continuous sampling effort through time and on the entire extension of the sampling area. In the Gulf of California, Moser *et al.* (1974) reported 27 different taxa not included by Aceves-Medina *et al.* (2003) (Table 4). Several studies conducted inside the gulf added 95 additional taxa. These studies covered from the north to the center of the gulf, and the area off Bahía de La Paz (Ávalos-García *et al.* 2003; Sánchez-Velasco *et al.* 2004; 2007; González-Armas *et al.* 2008; Peguero-Icaza *et al.* 2008; Avendaño-Ibarra *et al.* 2009; Contreras-Catala *et al.* 2012). Extensive sampling directed to a few commercial species carried out in the rocky reefs along the entire Gulf of California added only two new taxa in which adult fishes in spawning aggregations with eggs observed by diving were reported (Sala *et al.* 2003). Sampling from Franco-Gordo *et al.* (1999; 2003), Silva-Segundo *et al.* (2008), and León-Chávez *et al.* (2010) from the mouth of the gulf to the oceanic and coastal area in front of Jalisco-Colima contributed with 96 additional taxa. Finally, in our study, with an important sampling effort (315 samples) and area coverage (from the north of the Gulf of California to Bahía de Banderas), 76 new taxa not previously reported by the former authors were added. In terms of relative abundance, our study increased the number of taxa from the list of Aceves-Medina *et al.* (2003) by 25.7%, followed by Franco-Gordo *et al.* 1999 (15.5%), and Ávalos-García *et al.* (2003) (10.5%), which altogether contributed with 51.7% of the total new taxa added. The compiled list added more than 100% to the number of original taxa reported by Aceves-Medina *et al.* (2003).

Some discrepancies between the species names and also important changes in family names were found when compiling the list. These were due to the continuous change in the systematics of fishes to date. Fourteen species found in the analyzed lists changed: *Antennarius avalonis* to *Fowlerichthys avalonis* (Jordan & Starks, 1907), *Antennarius sanguineus* to *Antennatus sanguineus* (Gill, 1863), *Bathylagus nigrigenys* to *Bathylagoides nigrigenys* (Parr, 1931), *Encheliophis dubius* to *Carapus dubius* (Putnam, 1874), *Chaenopsis alepidota alepidota* to *Chaenopsis alepidota* (Gilbert, 1890), *Paraconger nitens* to *Rhynchoconger nitens* (Jordan & Bollman, 1890), *Cheilopogon heterurus hubbsi* to *Cheilopogon hubbsi* (Parin, 1961), *Fodiator acutus rostratus* to *Fodiator rostratus* (Günther, 1866), *Diplophos proximus* to *Diplophos taenia* Günther, 1873, *Tetrapturus audax* to *Kajikia audax* (Philippi, 1887), *Trichiurus nitens* to *Trichiurus lepturus* Linnaeus, 1758, *Enneanectes sexmaculatus* to *Enneanectes carminalis* (Jordan & Gilbert, 1882), *Auxis rochei* to *Auxis rochei rochei* (Risso, 1810), and *Sarda chiliensis* to *Sarda chiliensis chiliensis* (Cuvier, 1832). The Mirapinnidae family also changed to Cetomimidae, Atherinidae to Atherinopsidae, and *Etrumeus teres* (DeKay, 1842), in the Clupeidae family changed to the Dussumieriidae family. All these changes were according to the Catalog of Fishes (Eschmeyer 2013) and Fish Base (Froese and Pauly 2012) web pages.

Moser (1996) presented the most extensive work (50 years of ichthyoplanktonic research) to date in fish larvae taxonomy. Their sampling area covered from Oregon, USA to the southern tip of the Baja California peninsula,

Mexico and offshore to ca. 400 nm (early CalCOFI sampling program). In addition to this area, they had an important source of fish larvae for early life history studies from different expeditions, programs, and cruises such as NORPAC (Northeast Pacific, 20°–48° N, 111°–154° W), the CalCOFI cruises in the Gulf of California (23°–32° N, 107°–115° W), and EASTROPAC I and II (Eastern Tropical Pacific, 20° N–20° S, 76°–126° W), among others. They reported 141 families and 467 species in this large region. From the 306 taxa they reported to be distributed only in the Gulf of California or in the Mexican Tropical Pacific, 72 species have never been collected again. Our compiled taxonomic list included 423 species that represented approximately 48.3% of the 875 species recorded as adults in the Gulf of California (Thomson *et al*. 2000). All this indicates that our species records are still low. The high number of "forms" registered in some taxa: eight in the Gobiidae family (Table 4, Ávalos-García *et al*. 2003), or in the Anguilliformes order with ten forms (Table 4, this study), indicate that these forms may be an important source of species increment if they do represent species. The presence of several forms in our compiled list occurred in 14 families and one order: Bothidae, Chiasmodontidae, Clinidae, Congridae, Cyematidae, Eleotridae, Gobiesocidae, Gobiidae, Haemulidae, Labrisomidae, Macrouridae, Paralichthyidae, Pomacentridae, Sciaenidae families, and the Anguilliformes order (Table 4). Taking into account only the maximum number of forms reported in each one of them, around 65 more could be representing species. These results show that a strong taxonomic effort to describe fish larvae still needs to be done, particularly in the mentioned taxa that represent an opportunity to eliminate the gap in our knowledge of the fish larvae diversity in the Gulf of California.

There are more fish larvae studies inside the Gulf of California, but they did not include any different taxa to the date they were published and we did not use them. Taxonomic lists from the coastal lagoon and bays were also not included in our compiled list. Although coastal ecosystems in the Gulf of California are reservoirs of great biological diversity (Martínez-López *et al*. 2007), the exportation and contribution of shallow fish larvae to neritic or oceanic adjacent waters depends on several environmental variables and still needs to be investigated. A coastal sampling program covering the first 20 nm from the coast could be a first step to understand, not only the close to the coast fish larvae diversity, but several other oceanographic processes linking coastal to oceanic waters.

In terms of sampling, the most common sampling technique for fish larvae collection used by the authors in the compiled list was the oblique Bongo net tow; only two used opening-closing conical zooplankton nets (Sánchez-Velasco *et al*. 2007; Contreras-Catala *et al*. 2012), one did surface trawls with a conical net (González-Armas *et al*. 2008), and only Silva-Segundo *et al*. (2008) used oblique shallow trawls at very coastal sampling stations. Trawl selectivity of these sampling techniques, depth of tow, distance to the coast, mesoscale oceanographic processes such as eddies and fronts, intra- and interannual variability, locality, bathymetric differences along the study area, sampling frequency, and reproductive strategies of adult fishes, among other variables, could determine different species composition in the samples collected (Aceves-Medina *et al*. 2003; Franco-Gordo *et al*. 2008; Inda-Díaz 2010; Jiménez-Rosenberg *et al*. 2010).

The taxonomic list of fish larvae species from the Gulf of California to Colima compiled here represents the most extensive and comprehensive list presented to date. This list added more than twice the number of taxa previously reported by Aceves-Medina *et al*. (2003) but it still remains conservative in relation to the total number of adult fishes reported. The numerous "forms" pertaining to the family level reported in 14 families and one order showed the need to emphasize the taxonomic work as a primary tool to identify and understand the alpha diversity of the Gulf of California.

Table 3. Systematic list of fish larvae species registered in the Gulf of California to Colima, Mexico. A = Aceves-Medina et al. (2003), B = Moser *et al.* (1974), C = Ávalos-García *et al.* (2003), Sala *et al.* (2003), Sánchez-Velasco *et al.* (2004), Sánchez-Velazco *et al.* (2007), González-Armas *et al.* (2008), Peguero-Icaza *et al.* (2008), Avendaño-Ibarra *et al.* (2009), and Contreras-Catala *et al.* (2012). D = Franco-Gordo *et al.* (1999; 2003), Silva-Segundo *et al.* (2008), and León-Chávez *et al.* (2010). This study =Gulf of California to Jalisco, 2003-2007).

FAMILY	TAXA	A	B	C	D	This study
ELOPIDAE	*Elops affinis* Regan, 1909	X		X	X	
ALBULIDAE	*Albula vulpes* (Linnaeus, 1758)	X		X		X
	Albula sp. 1			X	X	X
	Albula spp.			X		
NOTACANTHIDAE	*Notacanthus chemnitzii* Bloch, 1788					X
	Notacanthidae	X				X
O. ANGUILLIFORMES	Anguilliforme		X	X	X	X
MURAEINIDAE	*Anarchias* sp. 1	X				
	Gymnothorax sp. 1	X			X	X
	Uropterygius sp. 1	X				
	Muraenidae	X		X	X	
OPHICHTHIDAE	*Myrophis vafer* Jordan & Gilbert 1882	X		X	X	X
	Myrophinae					X
	Ophichthus triserialis Kaup 1856	X		X	X	X
	Ophichthus zophochir Jordan & Gilbert, 1883	X		X	X	X
	Ophichthus sp. 1	X		X	X	X
	Ophichthidae	X		X	X	X
COLOCONGRIDAE	*Coloconger giganteus* (Castle, 1959)					X

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
CONGRIDAE	*Ariosoma gilberti* (Ogilby, 1898)	X		X	X	X
	Bathycongrus macrurus (Gilbert, 1891)	X		X	X	X
	Chiloconger dentatus (Garman, 1899)			X		X
	Chiloconger sp. 1	X				
	Gnathophis cinctus (Garman, 1899)	X				
	Heteroconger canabus (Cowan & Rosenblatt, 1974)				X	
	Heteroconger digueti (Pellegrin, 1923)			X	X	X
	Heteroconger sp. 1			X	X	X
	Paraconger californiensis Kanazawa, 1961			X	X	X
	Paraconger sp. 1	X				
	Rhynchoconger nitens (Jordan & Bollman, 1890)			X	X	X
	Rhynchoconger sp. 1					X
	Congridae	X		X	X	X
DERICHTHYDAE	*Derichthys serpentinus* Gill, 1884			X		
	Derichthyidae	X		X	X	
NEMICHTHYDAE	Nemichthyidae	X		X		
SERRIVOMERIDAE	Serrivomeridae	X		X		
NETTASTOMATIDAE	*Hoplunnis sicarius* (Garman, 1899)	X		X	X	
	Hoplunnis sp. 1	X				X
CYEMATIDAE	Cyematidae	X		X		
CLUPEIDAE	*Harengula thrissina* (Jordan & Gilbert, 1882)	X		X	X	
	Opisthonema libertate (Günther, 1867)	X		X	X	X
	Opisthonema sp. 1			X	X	X
	Opisthonema spp.		X	X		
	Sardinops sagax (Jenyns, 1842)	X	X	X		X
	Clupeidae	X		X		
DUSSUMIERIIDAE	*Etrumeus teres* (DeKay, 1842)	X	X	X	X	X
ENGRAULIDAE	*Anchoa* sp. 1			X	X	X
	Anchoa spp.			X		
	Cetengraulis mysticetus (Günther, 1867)			X	X	X
	Engraulis mordax Girard, 1854	X		X	X	X
	Engraulidae	X	X	X	X	X
CHANIDAE	*Chanos chanos* (Forsskål, 1775)					X
ARGENTINIDAE	*Argentina sialis* Gilbert, 1890	X	X	X	X	X
MICROSTOMATIDAE	Microstomatidae	X		X		
BATHYLAGIDAE	*Bathylagoides nigrigenys* (Parr, 1931)		X		X	X
	Bathylagus pacificus Gilbert, 1890	X				X
	Bathylagoides wesethi (Bolin, 1938)	X		X	X	X
	Bathylagoides sp. 1				X	
	Leuroglossus stilbius Gilbert, 1890	X	X	X		X
	Bathylagidae			X		X
GONOSTOMATIDAE	*Cyclothone acclinidens* Garman, 1899					X
	Cyclothone signata Garman, 1899					X
	Cyclothone spp.			X		X
	Diplophos taenia Günther, 1873	X	X	X	X	X
	Diplophos sp. 1					X
	Gonostomatidae			X		X
STERNOPTYCHIDAE	*Argyropelecus lychnus* Garman, 1899					X
	Argyropelecus sp. 1		X			
PHOSICHTHYIDAE	*Ichthyococcus irregularis* Rechnitzer & Böhlke, 1958	X				
	Vinciguerria lucetia (Garman, 1899)	X	X	X	X	X
	Vinciguerria nimbaria Jordan & Williams, 1895)					X
	Vinciguerria poweriae (Cocco, 1838)					X
	Woodsia nonsuchae (Beebe, 1932)					X
	Phosichthyidae				X	
STOMIIDAE	*Bathophilus filifer* (Garman, 1899)		X		X	
	Bathophilus flemingi Aron & McCrery, 1958				X	
	Idiacanthus antrostomus Gilbert, 1890				X	
	Stomias atriventer Garman, 1899	X	X	X		X
	Tactostoma macropus Bolin, 1939				X	

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
	Chauliodontinae				X	
	Melanostomiinae					X
	Stomiidae	X		X	X	
AULOPIDAE	*Aulopus bajacali* Parin & Kotlyar, 1984	X		X		X
	Aulopidae		X			
SCOPELARCHIDAE	*Scopelarchoides nicholsi* Parr, 1929	X	X	X	X	X
	Scopelarchus guentheri Alcock, 1896	X				
	Scopelarchidae	X				
SYNODONTIDAE	*Synodus lucioceps* (Ayres, 1855)	X		X	X	X
	Synodus evermanni Jordan & Bollman, 1890				X	
	Synodus sechurae Hildebrand, 1946			X	X	
	Synodus sp. 1			X	X	X
	Synodus sp. 2			X		X
	Synodus spp.	X	X			X
PARALEPIDIDAE	*Lestidiops neles* (Harry, 1953)	X		X	X	X
	Lestidiops pacificus (Parr, 1931)			X		
	Lestidiops sp. 1	X				
	Magnisudis atlantica (Krøyer, 1868)				X	
	Stemonosudis macrura (Ege, 1933)				X	
	Paralepididae		X			
EVERMANNELLIDAE	Evermannellidae				X	
NEOSCOPELIDAE	Neoscopelidae	X				
MYCTOPHIDAE	*Benthosema panamense* (Tåning, 1932)	X	X	X	X	X
	Bolinichthys longipes (Brauer, 1906)					X
	Ceratoscopelus townsendi (Eigenmann & Eigenmann, 1889)	X				X
	Diaphus pacificus Parr, 1931	X	X	X	X	X
	Diaphus sp. 1				X	
	Diogenichthys atlanticus (Tåning, 1928)				X	
	Diogenichthys laternatus (Garman, 1899)	X	X	X	X	X
	Gonichthys tenuiculus (Garman, 1899)	X			X	X
	Hygophum atratum (Garman, 1899)	X	X	X	X	X
	Hygophum proximum Becker, 1965				X	
	Hygophum reinhardtii (Lütken, 1892)			X	X	
	Lampanyctus macdonaldi (Goode & Bean, 1896)				X	
	Lampanyctus parvicauda Parr, 1931	X		X	X	X
	Lampanyctus spp.		X			
	Myctophum aurolaternatum Garman, 1899		X		X	X
	Nannobrachium idostigma (Parr, 1931)	X		X		X
	Nannobrachium sp. 1	X				
	Nannobrachium spp.					X
	Triphoturus mexicanus (Gilbert, 1890)	X	X	X	X	X
	Myctophidae	X	X	X	X	X
LOPHOTIDAE	*Lophotus lacepede* Giorna, 1809			X		
TRACHIPTERIDAE	*Zu cristatus* (Bonelli, 1819)	X				
	Trachipteridae	X				
BREGMACEROTIDAE	*Bregmaceros bathymaster* Jordan & Bollman, 1890	X	X	X	X	X
	Bregmaceros sp. 1	X		X	X	X
	Bregmacerotidae	X		X		
MACROURIDAE	*Caelorinchus scaphopsis* (Gilbert, 1890)	X		X		X
	Coryphaenoides sp. 1			X		X
	Nezumia sp. 1	X				
	Nezumia spp.			X	X	X
	Macrouridae		X			X
MORIDAE	*Laemonema verecundum* (Jordan & Cramer, 1897)				X	X
	Physiculus nematopus Gilbert, 1890	X		X		X
	Physiculus rastrelliger Gilbert, 1890			X		
	Physiculus sp. 1		X	X		X
MERLUCCIIDAE	*Merluccius productus* (Ayres, 1855)	X		X		X
	Merluccius sp. 1		X			
OPHIDIIDAE	*Brotula* sp. 1			X		

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
	Cherublemma emmelas (Gilbert, 1890)	X		X	X	X
	Chilara taylori (Girard, 1858)	X		X		X
	Lepophidium negropinna Hildebrand & Barton, 1949	X		X	X	X
	Lepophidium stigmatistium (Gilbert, 1890)	X		X	X	X
	Lepophidium sp. 1	X		X		X
	Ophidion scrippsae (Hubbs, 1916)	X		X	X	X
	Ophidion sp. 1	X		X	X	X
	Ophidiidae	X	X	X	X	X
CARAPIDAE	*Carapus dubius* (Putnam, 1874)	X		X	X	
	Encheliophis sp. 1	X				
	Echiodon exsilium Rosenblatt, 1961	X		X		X
	Carapidae	X	X			
BYTHITIDAE	Bythitidae	X			X	
BATRACHOIDIDAE	*Porichthys margaritatus* (Richardson, 1844)				X	
O. LOPHIIFORMES	Lophiforme					X
LOPHIIDAE	*Lophiodes caulinaris* (Garman, 1899)			X	X	X
	Lophiodes spilurus (Garman, 1899)	X		X	X	X
	Lophiodes sp. 1	X		X		
	Lophiidae	X	X			
ANTENNARIDAE	*Fowlerichthys avalonis* (Jordan & Starks, 1907)	X		X	X	
	Antennatus sanguineus (Gill, 1863)				X	
	Antennarius sp. 1	X				X
	Antennaridae			X		
OGCOCEPHALIDAE	*Zalieutes elater* (Jordan & Gilbert, 1882)	X		X	X	
	Ogcocephalidae					X
MELANOCETIDAE	*Melanocetus johnsoni* Günther, 1864				X	X
	Melanocetidae	X				
ONEIRODIDAE	*Dolopichthys* spp.					X
	Oneirodes acanthias (Gilbert, 1915)					X
	Oneirodes sp. 1	X				
	Oneirodes spp.			X	X	X
	Oneirodidae	X				
CERATIIDAE	Ceratiidae					X
GIGANTACTINIDAE	*Gigantactis* sp. 1	X				X
	Gigantactinidae		X			
LINOPHRYNIDAE	*Borophryne apogon* Regan, 1925	X				X
GOBIESOCIDAE	*Gobiesox eugrammus* Briggs, 1955				X	
	Gobiesox papillifer Gilbert, 1890				X	
	Gobiesox sp. 1				X	X
	Gobiesocidae				X	X
ATHERINOPSIDAE	*Atherinella nepenthe* (Myers & Wade, 1942)				X	
	Atherinella sp. 1				X	
	Atherinops affinis (Ayres, 1860)					X
	Atherinopsidae	X	X			
BELONIDAE	*Strongylura exilis* (Girard, 1854)			X		
HEMIRAMPHIDAE	*Hemiramphus saltator* Gilbert & Starks, 1904			X	X	X
	Hemiramphus spp.					X
	Hyporhamphus rosae (Jordan & Gilbert, 1880)	X		X	X	X
	Hyporhamphus spp.					X
	Oxyporhamphus micropterus micropterus (Valenciennes, 1847)	X		X	X	X
	Hemiramphidae	X	X	X	X	
EXOCOETIDAE	*Cheilopogon hubbsi* (Parin, 1961)			X	X	X
	Cheilopogon pinnatibarbatus californicus (Cooper, 1863)	X				X
	Cheilopogon xenopterus (Gilbert, 1890)					X
	Cheilopogon sp. 1			X		
	Cheilopogon spp.					X
	Exocoetus volitans Linnaeus, 1758			X		
	Fodiator rostratus (Günther, 1866)	X				X
	Hirundichthys rondeletii (Valenciennes, 1847)	X		X		
	Hirundichthys spp.	X				X

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
	Prognichthys tringa Breder, 1928	X		X		X
	Prognichthys spp.					X
	Exocoetidae	X			X	X
MELAMPHAIDAE	*Melamphaes lugubris* Gilbert, 1890				X	
	Melamphaes sp. 1			X	X	X
	Melamphaes spp.	X				
	Scopelogadus mizolepis bispinosus (Gilbert, 1915)	X		X	X	X
	Melamphaidae		X	X		X
HOLOCENTRIDAE	*Myripristis leiognathos* Valenciennes, 1846	X		X	X	X
	Myripristis spp.	X				
	Sargocentron suborbitalis (Gill, 1863)					X
	Holocentridae					X
CETOMIMIDAE	*Eutaeniophorus festivus* (Bertelsen & Marshall, 1956)					X
	Cetomimidae	X				
FISTULARIIDAE	*Fistularia commersonii* Rüppell, 1838	X		X		X
	Fistularia corneta Gilbert & Starks, 1904	X		X	X	X
	Fistulariidae		X			
SYNGNATHIDAE	*Doryrhamphus excisus excisus* Kaup, 1856			X	X	
	Hippocampus ingens Girard, 1858			X		
	Syngnathus californiensis Storer, 1845			X		
	Syngnathus sp. 1	X				X
	Syngnathidae		X			
SCORPAENIDAE	*Pontinus furcirhinus* Garman, 1899				X	
	Pontinus sierra (Gilbert, 1890)	X		X		
	Pontinus sp. 1			X	X	X
	Pontinus sp. 2					X
	Pontinus spp.	X				X
	Scorpaena guttata Girard, 1854	X		X	X	X
	Scorpaena sp. 1				X	X
	Scorpaena spp.	X				
	Scorpaenodes xyris (Jordan & Gilbert, 1882)	X		X	X	X
	Scorpaenodes spp.					X
	Sebastes constellatus (Jordan & Gilbert, 1880)			X		
	Sebastes macdonaldi (Eigenmann & Beeson, 1893)	X				
	Sebastes sp. 1			X		
	Sebastes sp. 2			X		
	Sebastes sp. 3			X		X
	Sebastes sp. 6					X
	Sebastes spp.	X	X	X		X
	Sebastolobus altivelis Gilbert, 1896	X		X		X
	Scorpaenidae	X		X	X	X
TRIGLIDAE	*Bellator loxias* (Jordan, 1897)	X		X		
	Prionotus ruscarius Gilbert & Starks, 1904	X		X	X	X
	Prionotus stephanophrys Lockington, 1881	X		X		X
	Prionotus sp. 1					X
	Triglidae	X	X	X		X
CYCLOPTERIDAE	Cyclopteridae				X	
HOWELLIDAE	*Howella* sp. 1			X		
	Howella spp.	X				
POLYPRIONIDAE	*Stereolepis gigas* Ayres, 1859					X
SERRANIDAE	Anthiinae			X		
	Diplectrum pacificum Meek & Hildebrand, 1925			X		
	Diplectrum sp. 1			X	X	X
	Diplectrum sp. 2			X		X
	Diplectrum spp.	X		X		X
	Epinephelus sp. 1			X		X
	Epinephelus spp.	X				X
	Hemanthias peruanus (Steindachner, 1875)					X
	Hemanthias signifer (Garman, 1899)	X		X		X
	Hemanthias sp. 1			X		X

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
	Hemanthias spp.	X				
	Mycteroperca prionura Rosenblatt & Zahuranec, 1967			X		
	Mycteroperca rosacea (Streets, 1877)			X		
	Mycteroperca spp.	X				
	Paralabrax auroguttatus Walford, 1936			X		X
	Paralabrax maculatofasciatus (Steindachner, 1868)	X		X		X
	Paralabrax nebulifer (Girard, 1854)				X	X
	Paralabrax sp. 1			X		X
	Paralabrax sp. 2			X		X
	Paranthias colonus (Valenciennes, 1846)	X		X	X	
	Paranthias sp. 1				X	
	Pronotogrammus eos Gilbert, 1890			X		X
	Pronotogrammus multifasciatus Gill, 1863	X		X		X
	Pronotogrammus spp.					X
	Pseudogramma thaumasia (Gilbert, 1900)	X			X	
	Serranus sp. 1			X	X	X
	Serranus sp. 2			X	X	X
	Serranus sp. 3				X	
	Serranus sp. 4					X
	Serranus spp.	X				X
	Serranidae	X	X	X		X
OPISTOGNATHIDAE	*Opistognathus* sp. 1			X	X	
	Opistognathus spp.	X				
PRIACANTHIDAE	*Heteropriacanthus cruentatus* (Lacepède, 1801)					X
	Pristigenys serrula (Gilbert, 1891)	X		X		X
	Priacanthidae	X			X	X
APOGONIDAE	*Apogon atricaudus* Jordan & McGregor, 1898			X	X	
	Apogon guadalupensis (Osburn & Nichols, 1916)			X		
	Apogon retrosella (Gill, 1862)	X		X	X	X
	Apogon sp. 1					X
	Apogon spp.	X				
	Apogonidae	X	X	X	X	X
MALACANTHIDAE	*Caulolatilus affinis* Gill, 1865					X
	Caulolatilus princeps (Jenyns, 1840)	X		X		X
	Caulolatilus sp. 1					X
	Malacanthidae		X			
CARANGIDAE	*Alectis ciliaris* (Bloch, 1787)	X				X
	Caranx caballus Günther, 1868	X		X	X	X
	Caranx sexfasciatus Quoy & Gaimard, 1825	X		X	X	X
	Caranx sp. 1			X	X	X
	Caranx sp. 2			X		
	Caranx spp.	X				
	Chloroscombrus orqueta Jordan & Gilbert, 1883	X		X	X	X
	Decapterus sp. 1			X	X	X
	Decapterus spp.	X		X		
	Elagatis bipinnulata (Quoy & Gaimard, 1825)	X				
	Gnathanodon speciosus (Forsskål, 1775)	X				X
	Hemicaranx spp.					X
	Naucrates ductor (Linnaeus, 1758)			X	X	X
	Oligoplites saurus (Bloch & Schneider, 1801)	X		X		X
	Oligoplites sp. 1	X		X		X
	Oligoplites sp. 2					X
	Selar crumenophthalmus (Bloch, 1793)	X		X		X
	Selene brevoortii (Gill, 1863)	X			X	
	Selene orstedii Lütken, 1880					X
	Selene peruviana (Guichenot, 1866)	X		X	X	X
	Selene spp.	X				X
	Seriola lalandi Valenciennes, 1833	X		X	X	X
	Seriola sp. 1			X	X	X
	Seriola sp. 2					X

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
	Seriola sp. 3					X
	Seriola spp.	X				
	Trachinotus kennedyi Steindachner, 1876				X	X
	Trachinotus rhodopus Gill, 1863	X				X
	Trachurus symmetricus (Ayres, 1855)	X		X	X	X
	Carangidae	X	X	X	X	X
NEMATISTIIDAE	*Nematistius pectoralis* Gill, 1862	X				
CORYPHAENIDAE	*Coryphaena equiselis* Linnaeus, 1758					X
	Coryphaena hippurus Linnaeus, 1758	X		X	X	X
	Coryphaenidae		X			
BRAMIDAE	Bramidae	X	X		X	
LUTJANIDAE	*Hoplopagrus guentherii* Gill, 1862					X
	Lutjanus argentiventris (Peters, 1869)	X		X	X	X
	Lutjanus guttatus (Steindachner, 1869)	X			X	
	Lutjanus novemfasciatus Gill, 1862	X		X	X	X
	Lutjanus peru (Nichols & Murphy, 1922)	X		X	X	X
	Lutjanus spp.	X				X
	Lutjanidae	X	X			
LOBOTIDAE	*Lobotes surinamensis* (Bloch, 1790)				X	
GERREIDAE	*Diapterus peruvianus* (Cuvier, 1830)	X		X		
	Eucinostomus argenteus Baird & Girard, 1855			X		
	Eucinostomus currani Zahuranec, 1980	X				X
	Eucinostomus dowii (Gill, 1863)	X		X		X
	Eucinostomus entomelas Zahuranec, 1980				X	
	Eucinostomus gracilis (Gill, 1862)	X		X	X	
	Eucinostomus spp.				X	
	Gerreidae	X	X			X
HAEMULIDAE	*Anisotremus davidsoni* (Steindachner, 1876)	X		X		X
	Anisotremus spp.	X				
	Conodon serrifer Jordan & Gilbert, 1882			X		
	Orthopristis reddingi Jordan & Richardson, 1895			X		
	Orthopristis spp.	X				
	Pomadasys sp. 1					X
	Xenistius californiensis (Steindachner, 1876)	X		X	X	
	Haemulidae	X	X	X	X	X
SPARIDAE	*Calamus brachysomus* (Lockington, 1880)	X		X		X
SCIAENIDAE	*Bairdiella* sp. 1			X	X	
	Cynoscion sp. 1				X	X
	Cheilotrema saturnum (Girard, 1858)				X	
	Larimus sp. 1				X	
	Larimus sp. 2				X	
	Menticirrhus undulatus (Girard, 1854)	X				
	Menticirrhus sp. 1				X	X
	Menticirrhus spp.			X		
	Micropogonias sp. 1				X	
	Micropogonias sp. 2				X	
	Micropogonias spp.					X
	Roncador stearnsii (Steindachner, 1876)	X		X		
	Seriphus politus Ayres, 1860	X				
	Umbrina roncador Jordan & Gilbert, 1882	X		X		
	Umbrina xanti Gill, 1862					X
	Umbrina sp. 1				X	X
	Sciaenidae	X	X	X	X	X
POLYNEMIDAE	*Polydactylus approximans* (Lay & Bennett, 1839)	X		X	X	X
	Polydactylus opercularis (Gill, 1863)	X		X		
	Polynemidae		X			
MULLIDAE	*Mulloidichthys dentatus* (Gill, 1862)			X		X
	Mullidae	X		X		X
KYPHOSIDAE	*Hermosilla azurea* Jenkins & Evermann, 1889			X		
	Kyphosus analogus (Gill, 1862)					X

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
	Kyphosus sp. 1			X		
	Medialuna californiensis (Steindachner, 1876)			X		X
	Kyphosidae	X	X	X	X	X
CHAETODONTIDAE	*Chaetodon humeralis* Günther, 1860			X		X
	Chaetodon sp. 1					X
	Chaetodontidae	X				X
CIRRHITIDAE	*Cirrhitichthys oxycephalus* (Bleeker, 1855)			X		
	Cirrhitidae			X	X	X
MUGILIDAE	*Mugil cephalus* Linnaeus, 1758	X		X	X	X
	Mugil curema Valenciennes, 1836			X		X
	Mugil sp. 1			X	X	
	Mugil spp.					X
	Mugilidae	X	X		X	X
POMACENTRIDAE	*Abudefduf troschelii* (Gill, 1862)	X		X	X	X
	Chromis punctipinnis (Cooper, 1863)			X		
	Chromis sp. 1	X		X	X	X
	Chromis sp. 2	X				
	Hypsypops rubicundus (Girard, 1854)	X		X		X
	Stegastes rectifraenum (Gill, 1862)	X		X	X	X
	Pomacentridae	X	X	X	X	X
LABRIDAE	*Decodon melasma* Gomon, 1974					X
	Halichoeres dispilus (Günther, 1864)	X		X	X	
	Halichoeres semicinctus (Ayres, 1859)	X		X	X	X
	Halichoeres sp. 1			X	X	X
	Halichoeres spp.	X				X
	Iniistius pavo (Valenciennes, 1840)			X		
	Oxyjulis californica (Günther, 1861)	X				
	Semicossyphus pulcher (Ayres, 1854)	X		X	X	
	Thalassoma sp. 1			X	X	X
	Thalassoma spp.	X		X		
	Xyrichthys mundiceps Gill, 1862	X		X	X	X
	Xyrichthys pavo (Valenciennes, 1840)	X				
	Xyrichthys sp. 1			X	X	X
	Labridae	X	X	X	X	X
SCARIDAE	*Nicholsina denticulata* (Evermann & Radcliffe,			X		
	Scarus sp. 1				X	X
	Scarus spp.	X				
	Scaridae					X
CHIASMODONTIDAE	*Chiasmodon niger* Johnson, 1864	X				X
	Chiasmodontidae	X			X	
AMMODYTIDAE	*Ammodytoides gilli* (Bean, 1895)			X	X	X
	Ammodytoides sp. 1				X	
SO. BLENNIOIDEI	Blennioidei			X		
TRIPTERYGIIDAE	*Enneanectes carminalis* (Jordan & Gilbert, 1882)				X	
	Tripterygiidae	X				
LABRISOMIDAE	*Labrisomus multiporosus* Hubbs, 1953				X	
	Labrisomus xanti Gill, 1860	X		X	X	X
	Paraclinus sp. 1				X	
	Labrisomidae			X	X	X
CLINIDAE	Clinidae		X			X
CHAENOPSIDAE	*Chaenopsis alepidota* (Gilbert, 1890)				X	
	Neoclinus blanchardi Girard, 1858			X		
	Chaenopsidae			X		X
DACTYLOSCOPIDAE	*Dactylagnus mundus* Gill, 1863				X	
	Dactyloscopus sp. 1				X	
	Gillellus semicinctus Gilbert, 1890			X	X	
	Myxodagnus opercularis Gill, 1861				X	
	Dactyloscopidae				X	
BLENNIIDAE	*Entomacrodus chiostictus* (Jordan & Gilbert, 1882)				X	
	Hypsoblennius brevipinnis (Günther, 1861)			X	X	

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
	Hypsoblennius gentilis (Girard, 1854)	X		X		X
	Hypsoblennius gilberti (Jordan, 1882)					X
	Hypsoblennius jenkinsi (Jordan & Evermann, 1896)	X				X
	Hypsoblennius proteus (Krejsa, 1960)			X		
	Hypsoblennius sp. 1			X	X	X
	Hypsoblennius spp.	X				
	Ophioblennius steindachneri Jordan & Evermann, 1898	X		X	X	X
	Plagiotremus azaleus (Jordan & Bollman, 1890)			X		
	Blenniidae	X		X		
CALLIONYMIDAE	*Synchiropus atrilabiatus* (Garman, 1899)			X	X	X
ELEOTRIDAE	*Dormitator latifrons* (Richardson, 1844)				X	
	Eleotris picta Kner, 1863			X		
	Erotelis armiger (Jordan & Richardson, 1895)	X		X		X
	Eleotridae	X		X	X	X
GOBIIDAE	*Bollmania* sp. 1				X	
	Coryphopterus nicholsi (Bean, 1882)				X	
	Coryphopterus sp. 1	X		X		
	Ctenogobius manglicola (Jordan & Starks, 1895)			X		
	Ctenogobius sagittula (Günther, 1862)			X		
	Gillichthys mirabilis Cooper, 1864	X				
	Gobulus crescentalis (Gilbert, 1892)	X		X		
	Gobionellus sp. 1				X	
	Ilypnus gilberti (Eigenmann & Eigenmann, 1889)	X				X
	Lythrypnus dalli (Gilbert, 1890)	X		X		X
	Lythrypnus zebra (Gilbert, 1890)			X		X
	Lythrypnus spp.	X			X	
	Microgobius sp. 1					X
	Quietula y-cauda (Jenkins & Evermann, 1889)	X				
	Rhinogobiops nicholsii (Bean, 1882)			X		X
	Gobiidae	X	X	X	X	X
MICRODESMIDAE	*Clarkichthys bilineatus* (Clark, 1936)	X		X	X	X
	Microdesmus sp. 1					X
	Microdesmidae	X	X		X	X
EPHIPPIDAE	*Chaetodipterus zonatus* (Girard, 1858)	X			X	X
	Parapsettus panamensis (Steindachner, 1876)	X				
	Ephippidae			X	X	
ACANTHURIDAE	Acanthuridae				X	X
SPHYRAENIDAE	*Sphyraena argentea* Girard, 1854	X				
	Sphyraena ensis Jordan & Gilbert, 1882	X		X	X	X
	Sphyraena lucasana Gill, 1863	X				
	Sphyraena sp. 1				X	
	Sphyraenidae		X			
GEMPYLIDAE	*Gempylus serpens* Cuvier, 1829	X				X
	Gempylidae	X	X	X		
TRICHIURIDAE	*Lepidopus fitchi* Rosenblatt & Wilson, 1987	X		X		X
	Trichiurus lepturus Linnaeus, 1758	X		X		X
	Trichiuridae	X	X			
SCOMBRIDAE	*Acanthocybium solandri* (Cuvier, 1832)					X
	Auxis rochei rochei (Risso, 1810)					X
	Auxis thazard thazard (Lacepède, 1800)					X
	Auxis sp. 1		X		X	X
	Auxis sp. 2				X	
	Auxis spp.	X		X		
	Euthynnus lineatus Kishinouye, 1920	X		X	X	X
	Euthynnus spp.		X			
	Katsuwonus pelamis (Linnaeus, 1758)					X
	Sarda chiliensis chiliensis (Cuvier, 1832)	X	X			
	Sarda sp. 1	X			X	
	Scomber japonicus Houttuyn, 1782	X	X	X		X
	Scomberomorus sierra Jordan & Starks, 1895			X		X

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
	Scomberomorus sp. 1		X			X
	Thunnus albacares (Bonnaterre, 1788)			X		
	Thunnus sp. 1					X
	Thunnus spp.	X				
	Scombridae					X
ISTIOPHORIDAE	*Istiophorus platypterus* (Shaw, 1792)					X
	Kajikia audax (Philippi, 1887)			X		X
NOMEIDAE	*Cubiceps pauciradiatus* Günther, 1872	X		X	X	X
	Cubiceps spp.	X				X
	Nomeus gronovii (Gmelin, 1789)					X
	Psenes pellucidus Lütken, 1880			X	X	X
	Psenes sio Haedrich, 1970	X		X	X	X
	Psenes sp. 1	X				X
	Nomeidae	X	X	X		X
TETRAGONURIDAE	Tetragonuridae		X		X	
STROMATEIDAE	*Peprilus simillimus* (Ayres, 1860)			X		
	Peprilus sp. 1	X				
	Stromateidae	X	X			
PARALICHTHYIDAE	*Citharichthys fragilis* Gilbert, 1890	X		X	X	X
	Citharichthys gordae Beebe & Tee-Van, 1938	X		X	X	X
	Citharichthys platophrys Gilbert, 1891	X		X	X	X
	Citharichthys sordidus (Girard, 1854)			X	X	X
	Citharichthys xanthostigma Gilbert, 1890					X
	Citharichthys sp. 1			X	X	X
	Citharichthys sp. 2			X		
	Citharichthys spp.	X		X	X	X
	Cyclopsetta panamensis (Steindachner, 1876)	X			X	X
	Cyclopsetta querna (Jordan & Bollman, 1890)					X
	Cyclopsetta sp. 1			X		X
	Etropus crossotus Jordan & Gilbert, 1882	X		X	X	X
	Etropus peruvianus Hildebrand, 1946				X	
	Etropus sp. 1			X		
	Etropus spp.					X
	Hippoglossina stomata Eigenmann & Eigenmann, 1890	X		X		X
	Paralichthys californicus (Ayres, 1859)	X				X
	Paralichthys woolmani Jordan & Williams, 1897	X			X	
	Paralichthys sp. 1			X		
	Syacium latifrons (Jordan & Gilbert, 1882)				X	X
	Syacium ovale (Günther, 1864)	X		X	X	X
	Syacium sp. 1					X
	Xystreurys liolepis Jordan & Gilbert, 1880	X				X
	Paralichthyidae	X		X		X
BOTHIDAE	*Bothus leopardinus* (Günther, 1862)	X		X	X	X
	Bothus sp. 1					X
	Engyophrys sanctilaurentii Jordan & Bollman, 1890	X		X	X	
	Monolene asaedai Clark, 1936	X		X	X	X
	Perissias taeniopterus (Gilbert, 1890)	X			X	X
	Bothidae		X			X
PLEURONECTIDAE	*Hypsopsetta guttulata* (Girard, 1856)	X		X		
	Pleuronichthys verticalis Jordan & Gilbert, 1880	X		X		X
	Pleuronectidae			X		
ACHIRIDAE	*Achirus mazatlanus* (Steindachner, 1869)	X		X	X	X
CYNOGLOSSIDAE	*Symphurus atramentatus* Jordan & Bollman, 1890			X	X	X
	Symphurus atricaudus (Jordan & Gilbert, 1880)	X		X	X	X
	Symphurus callopterus Munroe & Mahadeva, 1989			X	X	X
	Symphurus chabanaudi Mahadeva & Munroe, 1990				X	X
	Symphurus elongatus (Günther, 1868)				X	X
	Symphurus oligomerus Mahadeva & Munroe, 1990			X	X	X
	Symphurus prolatinaris Munroe, Nizinski & Mahadeva, 1991				X	
	Symphurus williamsi Jordan & Culver, 1895	X		X	X	X

TABLE 3. ***CONTINUED.***

FAMILY	TAXA	A	B	C	D	This study
	Symphurus sp. 1			X	X	X
	Symphurus sp. 2			X	X	X
	Symphurus sp. 4				X	X
	Symphurus sp. 8			X	X	
	Symphurus spp.	X	X	X		X
	Cynoglossidae					X
BALISTIDAE	*Balistes polylepis* Steindachner, 1876	X		X	X	X
	Canthidermis maculata (Bloch, 1786)					X
	Sufflamen verres (Gilbert & Starks, 1904)				X	X
	Balistidae		X		X	X
MONACANTHIDAE	*Aluterus scriptus* (Osbeck, 1765)			X	X	X
	Monacanthidae				X	
TETRAODONTIDAE	*Sphoeroides annulatus* (Jenyns, 1842)	X		X	X	X
	Sphoeroides lobatus (Steindachner, 1870)	X		X		X
	Sphoeroides sp. 1	X		X		
	Sphoeroides sp. 2			X		
	Sphoeroides spp.					X
	Tetraodontidae	X	X		X	X
DIODONTIDAE	*Diodon holocanthus* Linnaeus, 1758			X		X
	Diodon sp. 1				X	X
	Diodontidae					X

TABLE 4. Total number and relative abundance of taxa registered from the Gulf of California to Colima per author included in the compiled list. This study = (Gulf of California to Jalisco, 2003-2007). Nb = number of taxa used as baseline for comparison (Aceves-Medina et al. 2003); N = number of taxa registered; AT = number of additional taxa (not registered by previous authors to that date); AT % = relative abundance of additional taxa; TF = total number of forms, FF = number of morphological forms by family: Bot = Bothidae, Chi = Chiasmodontidae, Cli = Clinidae, Con = Congridae, Cye = Cyematidae, Eleo = Eleotridae, Gobie = Gobiesocidae, Gob = Gobiidae, Hae = Haemulidae, Lab = Labrisomidae, Mac = Macrouridae, Par = Paralichthyidae, Ple = Pleuronectidae, Pom = Pomacentridae, Sci = Sciaenidae, Ang = order Anguilliformes.

	Nb	N	AT	AT (%)	TF	FF
Aceves-Medina *et al.* 2003	283				2	2 Gob
Moser *et al.* 1974		46	27	9.1	0	0
Franco-Gordo *et al.* 1999		56	46	15.5	0	0
Ávalos-García *et al.* 2003		97	31	10.5	18	8 Gob, 4 Hae, 3 Pom, 3 Sia
Franco-Gordo *et al.* 2003		105	2	0.7	3	3 Gob
Sala *et al.* 2003		5	2	0.7	0	0
Sánchez-Velasco *et al.* 2004		81	6	2.0	8	4 Gob, 2 Hae, 2 Sci
Sánchez-Velasco *et al.* 2007		107	15	5.1	4	2 Pom, 2 Cye
González-Armas *et al.* 2008		71	18	6.1	0	0
Peguero-Icaza *et al.* 2008		68	5	1.7	7	5 Gob, 2 Ple
Silva-Segundo *et al.* 2008		52	25	8.4	20	5 Gobie, 7 Hae, 6 Lab, 2 Sci
Avendaño-Ibarra *et al.* 2009		93	18	6.1	3	3 Con
León-Chávez *et al.* 2010		124	23	7.8	11	2 Bot, 2 Chi, 2 Con, 3 Gob, 2 Ang
Contreras-Catala *et al.* 2012		49	2	0.7	14	3 Ele, 3 Gob, 6 Ang, 2 Par
This study		264	76	25.7	38	2 Cli, 3 Con, 7 Ele, 7 Gob, 2 Mac, 10 Ang, 2 Pom, 5 Sci
Total	283	296				

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